Problem 33

There are *F*/*S* packets. Each packet is S=80 bits. Time at which the last packet is received at the first router is $\frac{S+80}{R}\times\frac{F}{S}$ sec. At this time, the first F/S-2 packets are at the destination, and the F/S-1 packet is at the second router. The last packet must then be transmitted by the first router and the second router, with each transmission taking $\frac{S+80}{R}$ sec. Thus delay in sending the whole file is $delay=\frac{S+80}{R}\times(\frac{F}{S}+2)$

To calculate the value of S which leads to the minimum delay,

$\frac{d}{dS}delay=0\Rightarrow S=\sqrt{40F}$

Chapter 2

Problem 3

Application layer protocols: DNS and HTTP
Transport layer protocols: UDP for DNS; TCP for HTTP

Problem 4

a) The document request was http://gaia.cs.umass.edu/cs453/index.html. The Host : field indicates the server's name and /cs453/index.html indicates the file name.

b) The browser is running HTTP version 1.1, as indicated just before the first <cr><lf> pair.

c) The browser is requesting a persistent connection, as indicated by the Connection: keep-alive.

d) This is a trick question. This information is not contained in an HTTP message anywhere. So there is no way to tell this from looking at the exchange of HTTP messages alone. One would need information from the IP datagrams (that carried the TCP segment that carried the HTTP GET request) to answer this question.

e) Mozilla/5.0. The browser type information is needed by the server to send different versions of the same object to different types of browsers.

Problem 5

a) The status code of 200 and the phrase OK indicate that the server was able to locate the document successfully. The reply was provided on Tuesday, 07 Mar 2008 12:39:45 Greenwich Mean Time.

b) The document index.html was last modified on Saturday 10 Dec 2005 18:27:46 GMT.

c) There are 3874 bytes in the document being returned.

d) The first five bytes of the returned document are : <!doc. The server agreed to a persistent connection, as indicated by the Connection: Keep-Alive field

Problem 8

a)

$$RTT_1 + \cdots + RTT_n + 2RTT_o + 8 \cdot 2RTT_o$$
$$= 18RTT_o + RTT_1 + \cdots + RTT_n .$$

b)

$$RTT_1 + \cdots + RTT_n + 2RTT_o + 2 \cdot 2RTT_o$$
$$= 6RTT_o + RTT_1 + \cdots + RTT_n$$

c)

$$RTT_1 + \cdots + RTT_n + 2RTT_o + RTT_o$$
$$= 3RTT_o + RTT_1 + \cdots + RTT_n .$$

Problem 20

We can periodically take a snapshot of the DNS caches in the local DNS servers. The Web server that appears most frequently in the DNS caches is the most popular server. This is because if more users are interested in a Web server, then DNS requests for that server are more frequently sent by users. Thus, that Web server will appear in the DNS caches more frequently.

For a complete measurement study, see:
Craig E. Wills, Mikhail Mikhailov, Hao Shang
“Inferring Relative Popularity of Internet Applications by Actively Querying DNS Caches”, in IMC'03, October 27-29, 2003, Miami Beach, Florida, USA